

Approved by:

_____/_____/_____
Process Engineer_____/_____/_____
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1 SCOPE

The purpose of this document is to detail the use of the Wet Bench for the etching of silicon, silicon nitride and oxide. All users are expected to have read and understood this document. It is not a substitute for in-person training on the system and is not sufficient to qualify a user on the system. Failure to follow guidelines in this document may result in loss of privileges.

2 REFERENCE DOCUMENTS

- SDSs for HF, Buffered Oxide Etch, Potassium Hydroxide and Phosphoric Acid.
- Wafab Operating Manual (for programming the constant temperature bath)

3 DEFINITIONS

KOH	-Potassium Hydroxide
HF	-Hydrofluoric Acid
BOE	-Buffered Oxide Etch
H ₃ PO ₄	-Phosphoric Acid
DI	-De-Ionized Water

4 TOOLS AND MATERIALS

- 4.1 General Description** - This bench is set up with two temperature controlled tanks to do orientation dependent etching of silicon and etching of silicon nitride. There are also four Teflon tanks which are not temperature controlled that may be used for etching with HF or BOE mixtures. There is one DI rinse tank which is manually operated.
- 4.2 Wafer Boats** - Only Teflon wafer boats and handles should be used for etching on this bench.

5 SAFETY PRECAUTIONS

5.1 Personal Safety Hazards

- 5.1.1 **Chemical Hazards** - Read and understand the SDS for the chemical being used. When using this bench safety gloves, chemical apron and a face shield are required, in addition to your safety glasses.
- 5.1.2 **Chemical Reaction** - This bench uses acids and bases; care should be taken not to mix them.
- 5.1.3 **Temperature** - The temperature-controlled baths are capable of heating chemicals to high temperatures which creates an additional burn hazard.
- 5.1.4 **Ventilation** - Make sure to open the vent behind the tank that you will be using and close the other vents. This will maximize the exhaust.
- 5.1.5 **Wafer Carriers** - Only Teflon wafer boats and handles should be used for etching on this bench.

5.2 Hazards to the Tool

- 5.2.1 **Contamination**-Wafers with gold or copper should not be introduced into this bench. Photoresist is not allowed in heated tanks.
- 5.2.2 **Contamination of other tools**- For KOH etching, there is a set of dedicated boats, handles, tweezers and a *manual rinse tank*. Do not use rinser/dryer after KOH etching. Wafers processed in KOH need to be put through a de-contamination clean before further processing.
- 5.2.3 **Tank Breakage** - Tanks are breakable, carefully place wafers in them.
- 5.2.4 **Fluid Level** - Never operate the heated tanks without the proper fluid level.

6 INSTRUCTIONS

6.1 Initial State Check

- 6.1.1 Only 1 heated tank should be used at a time to ensure proper exhaust.
- 6.1.2 Verify that the chemical you want to use is filled to the proper level.
- 6.1.3 Make sure that the bench has power and DI water.
- 6.1.4 Make sure that you have reserved the bench with the Tool Reservation System.

6.2 Resetting the System

- 6.2.1 The bench may be reset by cycling the bench power on and off. This is done using the **Main CTRL Power On** and **Emergency Power Off** buttons on the top right side of the bench.

6.3 Etching Silicon Nitride in Phosphoric Acid

- 6.3.1 Turn on the main power to the bench with the **Main CTRL Power On** button on the upper right side of the bench.
- 6.3.2 Start the **Bench Power Timer**. It will power the bench for 3 hours and will need to be reset if you need the bench longer.
- 6.3.3 Add 300mL of DI water to the phosphoric acid tank and **stir well** with a Teflon handle. *Do not add water to hot fluid.* Excess water will boil off as the tank heats to its set point. This will ensure that the concentration is correct, and that the acid is boiling at the set point. The system will maintain the concentration by periodically injecting a small amount of water. If the system starts out water deficient, the concentration will be too high and the acid will not boil at the set point.
- 6.3.4 Turn on the **Condenser** using the switch on the lower panel in front of the temperature controlled bath. Turn on the **Water Inject** with the switch on the top panel of the bench to the right of the controller.
- 6.3.5 On the appropriate controller, press **PWR** to turn on the power. Press the **SAVE/SIL** to silence the alarm. Only one heated tank should be used at a time.

- 6.3.6 Open the vent behind the tank that you will be using and close the other vents. This will maximize the exhaust.
- 6.3.7 On the controller, press **HOLD** to remove the system from the hold state and begin heating.
- 6.3.8 While the bath is heating up to 165C, occasionally stir it. The drip will begin as the bath nears the temperature set point. It should reach set point in about 45 minutes.
- 6.3.9 To silence an alarm, press the **SAVE/SIL** button.
- 6.3.10 Do *not* adjust the level sensor or the drip rate.
- 6.3.11 For nitride etching after a localized oxidation process, it may be necessary to do a buffered oxide etch (BOE) dip before etching in the phosphoric acid.
- 6.3.12 When the bath has reached the set point and is boiling rapidly, place the wafers in the etch bath using care not to drop them or splash the chemicals. *Do not* remove the boat handle. Put the lid on.
- 6.3.13 When the etch time has elapsed, remove wafers from the etch bath and place directly in the rinse tank. Do not bang the cassette on the side of the tank or shake the wafers over hot chemicals. Do not tilt the cassette during transport to prevent the handle from coming off. Rinse for 5 minutes.
- 6.3.14 To operate the rinse tank, close the drain and press the green water control button on the lower panel. The water will flow for about 10 minutes and automatically shut off.
- 6.3.15 When the etching is finished, press **PWR** to remove power from the controller.
- 6.3.16 Gloves should be rinsed and dried before hanging up. Use the water hose to carefully clean the bench. Dry when finished.
- 6.3.17 Make sure that the condenser switch is off, the water inject switch is off and the rinse tank water is off.
- 6.3.18 Turn off the bench power.

6.4 Etching Silicon in KOH

- 6.4.1 Turn on the main power to the bench with the **Main CTRL Power On** button on the upper right side of the bench.
- 6.4.2 Start the **Bench Power Timer**. It will power the bench for 3 hours and will need to be reset if you need the bench longer.
- 6.4.3 Turn on the **Condenser** using the switch on the lower panel in front of the temperature controlled bath. Turn on the **Water Inject** with the switch on the top panel of the bench to the right of the controller.
- 6.4.4 On the appropriate controller, press **PWR** to turn on the power. Press the **SAVE/SIL** to silence the alarm. Only one heated tank should be used at a time.
- 6.4.5 Open the vent behind the tank that you will be using and close the other vents. This will maximize the exhaust.
- 6.4.6 On the controller, press **HOLD** to remove the system from the hold state and begin heating.
- 6.4.7 While the bath is heating up, occasionally stir it with a Teflon handle. The drip will begin as the bath nears the temperature set point.
- 6.4.8 To silence an alarm, press the **SAVE/SIL** button.
- 6.4.9 Do *not* adjust the level sensor or the drip rate.
- 6.4.10 For KOH etching, use the dedicated cassettes and rinse tank to avoid cross contamination of other processes. These are located in the drawer under the bench and should be returned there when the etching is finished. If the wafers that have been KOH etched are to receive additional processing, they should be put through a decontamination clean and then RCA cleaned to avoid cross contamination. Avoid putting KOH contaminated wafers into the Rinser/Dryer. See the manual for the [Manual Processing Bench 2](#) for instructions on doing a decontamination clean.
- 6.4.11 When the bath has reached the set point, place the wafers in the etch bath using care not to drop them or splash the chemicals. Do *not* remove the boat handle.
- 6.4.12 When the etch time has elapsed, remove wafers from the etch bath and place directly in the dedicated rinse tank. Place rinse tank in sink with running water and rinse for 5 minutes. Do not bang the cassette on the side of the tank or shake the wafers over hot chemicals. Do not tilt the cassette during transport to prevent the handle from coming off.

6.3.13 When the etching is finished, press **PWR** to remove power from the controller.

6.3.14 Gloves should be rinsed and dried before hanging up. Use the water hose to carefully clean the bench. Dry when finished.

6.3.15 Make sure that the condenser switch is off, the water inject switch is off and the rinse tank water is off.

6.3.16 Turn off the bench power.

6.5 Errors during Run

6.5.1 If the controller alarms or does not heat, an interlock may be tripped. Contact an SMFL staff member.

6.5.2 If the heated process tanks are *not* stirred while they are heating up, they may boil over.

6.5.3 If a wafer falls out or breaks, do not attempt to retrieve it. Contact an SMFL staff member.

7 APPROPRIATE USES OF THE TOOL

7.1 The hot phosphoric acid bath is intended for etching silicon nitride.

7.2 The KOH bath is intended for orientation dependent etching of silicon.

REVISION RECORD

Summary of Changes	Originator	Rev/Date
Original Issue	Sean O'Brien	A-10/01/2002
Dedicated cassettes etc. for KOH etching	Sean O'Brien	B-11/27/2002
6.1.2 Delete N2 check/ added 7.7 and 8.1	Sean O'Brien	C-04/02/2003
Section 5 redone to match cert sheet and add no photoresist	Sean O'Brien	D-04/14/2003
Modified 6.3.3, 6.3.11, 6.3.13	Sean O'Brien	E-06/02/2004
Added 6.3.2 for Bench Power Timer	Sean O'Brien	F-08/02/2004
Changed procedure for decontamination clean to refer to instructions for Manual Processing Bench 2. Noted addition of water flow switch in 6.3.10.	Sean O'Brien	G-05/10/2005
Re-worked hazards and appropriate uses, added 5.1.4 and 6.3.6 to adjust vents, added 6.3.12, 6.3.13, 6.3.14,	Sean O'Brien	H-08/19/2009
Separated Nitride and KOH etch into two sections, changed 6.3.3	Sean O'Brien	I-01/20/2010
Updated format, added details and added section 6.1.1	Meller/O'Brien	J-05/15/2020